Storytelling Data Visualization on Exchange Rates

There are two types of Data Visualization:

- Exploratory Data Visualization: We create graphs for ourselves to better understand and explore data.
- Explanatory Data Visualization: We create graphs for others to inform, make a point, or tell a story. Throughout the project, we focused on explanatory data visualization and learned the following: i) How to use information design principles (familiarity and maximizing the data-ink ratio) to create better graphs for an audience. ii) About the elements of a story and how to create storytelling data visualizations using Matplotlib. iii) How to guide the audience's attention with pre-attentive attributes. iv) How to use Matplotlib built-in styles — with a case study on the FiveThirtyEight style.

In [1]:

```
import pandas as pd
import warnings

warnings.filterwarnings("ignore")
```

In [2]:

```
exchange_rates = pd.read_csv("euro-daily-hist_1999_2022.csv")
exchange_rates
```

Out[2]:

	Period\Unit:	[Australian dollar]	[Bulgarian lev]	[Brazilian real]	[Canadian dollar]	[Swiss franc]	[Chinese yuan renminbi]	[Cypriot pound]
0	2023-12-15	1.6324	1.9558	5.4085	1.4653	0.9488	7.7812	NaN
1	2023-12-14	1.6288	1.9558	5.3349	1.4677	0.949	7.7866	NaN
2	2023-12-13	1.6452	1.9558	5.3609	1.4644	0.9452	7.7426	NaN
3	2023-12-12	1.6398	1.9558	5.3327	1.4656	0.9443	7.7447	NaN
4	2023-12-11	1.642	1.9558	5.3169	1.4609	0.9478	7.7206	NaN
...	...	...	...	...	...	...	...	...
6451	1999-01-08	1.8406	NaN	NaN	1.7643	1.6138	NaN	0.58187
6452	1999-01-07	1.8474	NaN	NaN	1.7602	1.6165	NaN	0.58187
6453	1999-01-06	1.8820	NaN	NaN	1.7711	1.6116	NaN	0.58200
6454	1999-01-05	1.8944	NaN	NaN	1.7965	1.6123	NaN	0.58230
6455	1999-01-04	1.9100	NaN	NaN	1.8004	1.6168	NaN	0.58231

6456 rows × 41 columns

In [3]:
```
exchange_rates.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6456 entries, 0 to 6455
Data columns (total 41 columns):
 #   Column                     Non-Null Count  Dtype  
---  ------                     --------------  -----  
 0   Period\Unit:               6456 non-null   object 
 1   [Australian dollar ]       6456 non-null   object 
 2   [Bulgarian lev ]           6054 non-null   object 
 3   [Brazilian real ]          6188 non-null   object 
 4   [Canadian dollar ]         6456 non-null   object 
 5   [Swiss franc ]             6456 non-null   object 
 6   [Chinese yuan renminbi ]   6188 non-null   object 
 7   [Cypriot pound ]           2346 non-null   object 
 8   [Czech koruna ]            6456 non-null   object 
 9   [Danish krone ]            6456 non-null   object 
 10  [Estonian kroon ]          3130 non-null   object 
 11  [UK pound sterling ]       6456 non-null   object 
 12  [Greek drachma ]           520 non-null    object 
 13  [Hong Kong dollar ]        6456 non-null   object 
 14  [Croatian kuna ]           5941 non-null   object 
 15  [Hungarian forint ]        6456 non-null   object 
 16  [Indonesian rupiah ]       6456 non-null   object 
 17  [Israeli shekel ]          6188 non-null   object 
 18  [Indian rupee ]            6188 non-null   object 
 19  [Iceland krona ]           4049 non-null   float64
 20  [Japanese yen ]            6456 non-null   object 
 21  [Korean won ]              6456 non-null   object 
 22  [Lithuanian litas ]        4159 non-null   object 
 23  [Latvian lats ]            3904 non-null   object 
 24  [Maltese lira ]            2346 non-null   object 
 25  [Mexican peso ]            6456 non-null   object 
 26  [Malaysian ringgit ]       6456 non-null   object 
 27  [Norwegian krone ]         6456 non-null   object 
 28  [New Zealand dollar ]      6456 non-null   object 
 29  [Philippine peso ]         6456 non-null   object 
 30  [Polish zloty ]            6456 non-null   object 
 31  [Romanian leu ]            6394 non-null   float64
 32  [Russian rouble ]          5994 non-null   object 
 33  [Swedish krona ]           6456 non-null   object 
 34  [Singapore dollar ]        6456 non-null   object 
 35  [Slovenian tolar ]         2085 non-null   object 
 36  [Slovak koruna ]           2608 non-null   object 
 37  [Thai baht ]               6456 non-null   object 
 38  [Turkish lira ]            6394 non-null   float64
 39  [US dollar ]               6456 non-null   object 
 40  [South African rand ]      6456 non-null   object 
dtypes: float64(3), object(38)
memory usage: 2.0+ MB
```

In [4]:
```
exchange_rates.rename(columns={'[US dollar ]':'US_dollar',r'Period\Unit:':'T
```

In [5]:
```
exchange_rates["Time"] = pd.to_datetime(exchange_rates["Time"])
```

In [6]:
```
exchange_rates.sort_values("Time",inplace=True)
```

In [7]:
```
exchange_rates.head()
```

Out[7]:

	Time	[Australian dollar]	[Bulgarian lev]	[Brazilian real]	[Canadian dollar]	[Swiss franc]	[Chinese yuan renminbi]	[Cypriot pound]	[Czech koruna]
6455	1999-01-04	1.9100	NaN	NaN	1.8004	1.6168	NaN	0.58231	35.107
6454	1999-01-05	1.8944	NaN	NaN	1.7965	1.6123	NaN	0.58230	34.917
6453	1999-01-06	1.8820	NaN	NaN	1.7711	1.6116	NaN	0.58200	34.850
6452	1999-01-07	1.8474	NaN	NaN	1.7602	1.6165	NaN	0.58187	34.886
6451	1999-01-08	1.8406	NaN	NaN	1.7643	1.6138	NaN	0.58187	34.938

5 rows × 41 columns

In [8]:
```
euro_to_dollar = exchange_rates[["Time","US_dollar"]].copy()
euro_to_dollar["US_dollar"].value_counts()
```

Out[8]:
```
US_dollar
-         62
1.2276     9
1.1215     8
1.0888     7
1.0868     7
          ..
1.4304     1
1.4350     1
1.4442     1
1.4389     1
1.0804     1
Name: count, Length: 3769, dtype: int64
```

In [9]:
```
euro_to_dollar = euro_to_dollar[euro_to_dollar["US_dollar"]!= '-']
euro_to_dollar["US_dollar"] = euro_to_dollar["US_dollar"].astype(float)
euro_to_dollar.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 6394 entries, 6455 to 0
Data columns (total 2 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   Time       6394 non-null   datetime64[ns]
 1   US_dollar  6394 non-null   float64
dtypes: datetime64[ns](1), float64(1)
memory usage: 149.9 KB
```

Rolling Mean

In [10]:

```
import matplotlib.pyplot as plt
```

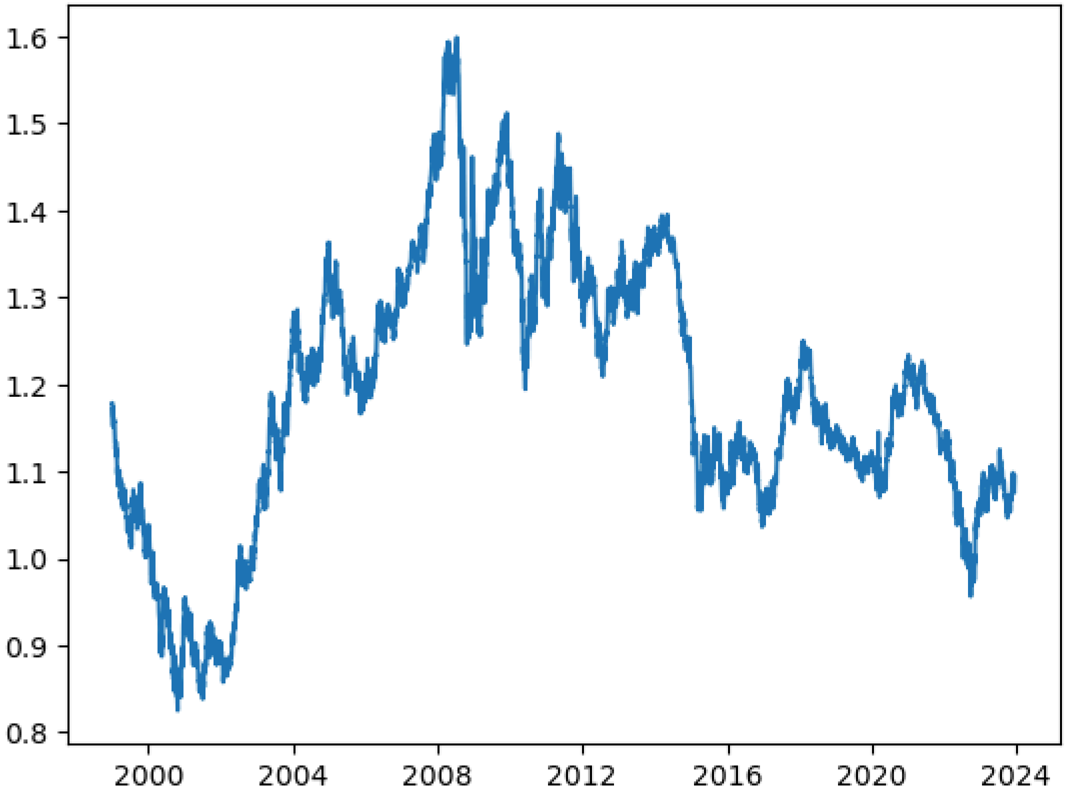
In [11]:

```
euro_to_dollar.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 6394 entries, 6455 to 0
Data columns (total 2 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   Time       6394 non-null   datetime64[ns]
 1   US_dollar  6394 non-null   float64
dtypes: datetime64[ns](1), float64(1)
memory usage: 149.9 KB
```

In [12]:

```
plt.plot(euro_to_dollar["Time"],euro_to_dollar["US_dollar"])
plt.show()
```



If we look at the line's shape, we see many small wiggles — rather than seeing a smooth line. The wiggles, however, have meaning : they are the visual representation of the daily variation in the exchange rate. The rate goes up and down, up and down again, day to day. The rate only shows clear upward or downward trends in the longer run (months or years).

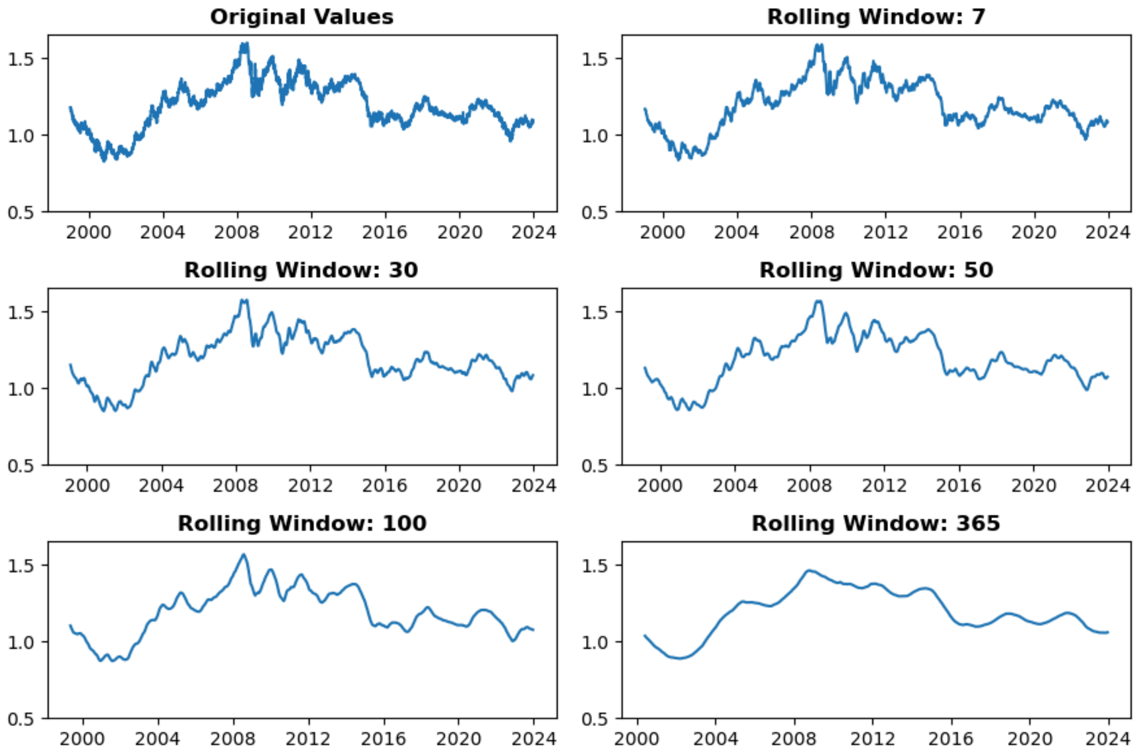
Depending on our goals, we may not want to show that daily variation on our graph. If we want to hide it and show only the long-term trends, we can use the rolling mean (also known as the moving average).

In [13]:

```
plt.figure(figsize = (9,6))
plt.subplot(3,2,1)
plt.plot(euro_to_dollar["Time"],euro_to_dollar["US_dollar"])
plt.title("Original Values",weight="bold")
plt.ylim(0.5,1.65,0.2)

for i,rolling_mean in zip([2,3,4,5,6],[7,30,50,100,365]):
    plt.subplot(3,2,i)
    plt.plot(euro_to_dollar["Time"],euro_to_dollar["US_dollar"]\
             .rolling(rolling_mean).mean())
    plt.title("Rolling Window: "+ str(rolling_mean),weight="bold")
    plt.ylim(0.5,1.65,0.2)

plt.tight_layout()
plt.show()
```



Ideas

- We will show how the euro-dollar rate has changed during coronavirus pandemic. We can show the 2020 data and the 2016-2019 as a baseline.
- We will show how the euro-dollar rate has changed during 2007-2008 crisis. We can also show the data for 2006 and 2009 for comparison.
- We will show how the euro-dollar rate has changed under the last three US presidents (George W.Bush(2001-2009), Barack Obama(2009-2017) and Donald Trump(2017-2021)).

In [14]:

```
euro_to_dollar["rolling_mean"] = euro_to_dollar['US_dollar'].rolling(30).mea
euro_to_dollar
```

Out[14]:

	Time	US_dollar	rolling_mean
6455	1999-01-04	1.1789	NaN
6454	1999-01-05	1.1790	NaN
6453	1999-01-06	1.1743	NaN
6452	1999-01-07	1.1632	NaN
6451	1999-01-08	1.1659	NaN
...	...	...	...
4	2023-12-11	1.0757	1.080143
3	2023-12-12	1.0804	1.080760
2	2023-12-13	1.0787	1.081593
1	2023-12-14	1.0919	1.082453
0	2023-12-15	1.0946	1.083267

6394 rows × 3 columns

Financial crisis 2007 - 2008

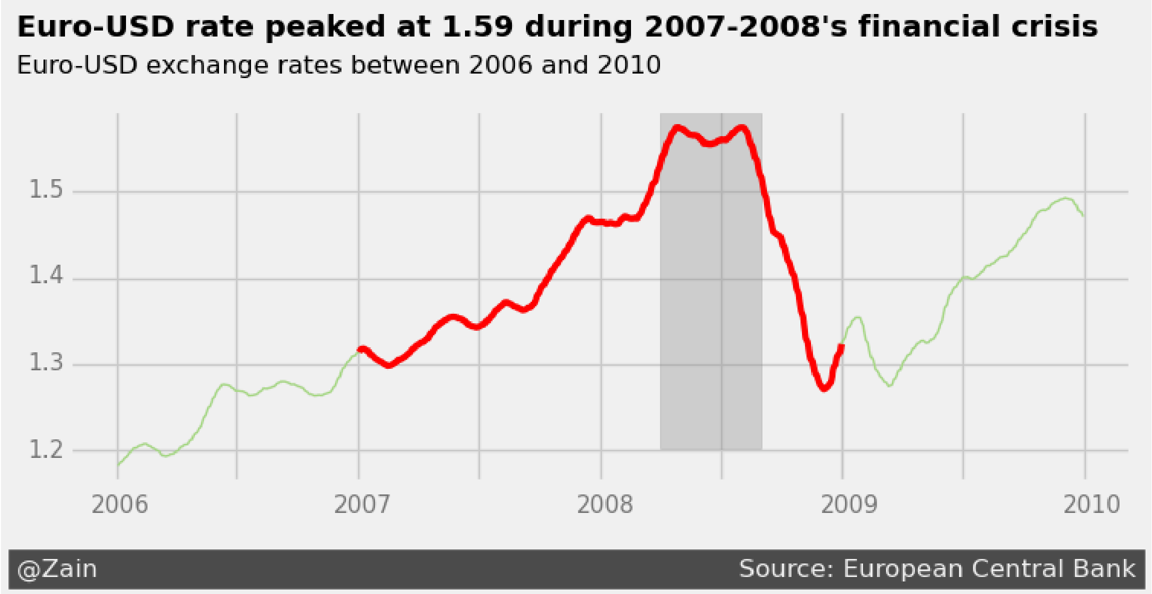
In [15]:

```
financial_crisis = euro_to_dollar.copy()[(euro_to_dollar["Time"].dt.year >=
financial_crisis_7_8 = euro_to_dollar.copy()[(euro_to_dollar["Time"].dt.year
```

In [16]:

```
import matplotlib.style as style
style.use("fivethirtyeight")
# Adding the plot
fig, ax = plt.subplots(figsize=(8,3))
ax.plot(financial_crisis["Time"],financial_crisis["rolling_mean"],
       linewidth = 1, color = "#A6D785")
# Highlighting 2007-2008 period
ax.plot(financial_crisis_7_8["Time"],
       financial_crisis_7_8["rolling_mean"],
       linewidth = 3, color = "red")
ax.axvspan(xmin = pd.to_datetime('2008-04-1'),xmax=pd.to_datetime('2008-09-1
# Labels
ax.set_xticklabels([])
x = 0.02
for year in ['2006','2007','2008','2009','2010']:
    ax.text(x,-0.08,year,alpha = 0.5,fontsize=11,\
            transform = plt.gca().transAxes)
    x+=0.22888
ax.set_yticklabels([])
y = 0.07
for rate in ['1.2','1.3','1.4','1.5']:
    ax.text(-0.04,y,rate,alpha=0.5,fontsize=11,\
            transform = plt.gca().transAxes)
    y+=0.2333
# Adding a title and subtitle
ax.text(-0.05,1.2,"Euro-USD rate peaked at 1.59 during 2007-2008's financial
        transform = plt.gca().transAxes)
ax.text(-0.05,1.1,"Euro-USD exchange rates between 2006 and 2010",size=12,tr
# Adding a signature
ax.text(-0.05,-0.25,'@Zain' + ' '*80 + 'Source: European Central Bank',
       color = '#f0f0f0', backgroundcolor="#4d4d4d",size=12,transform=plt.gc


plt.show()
```



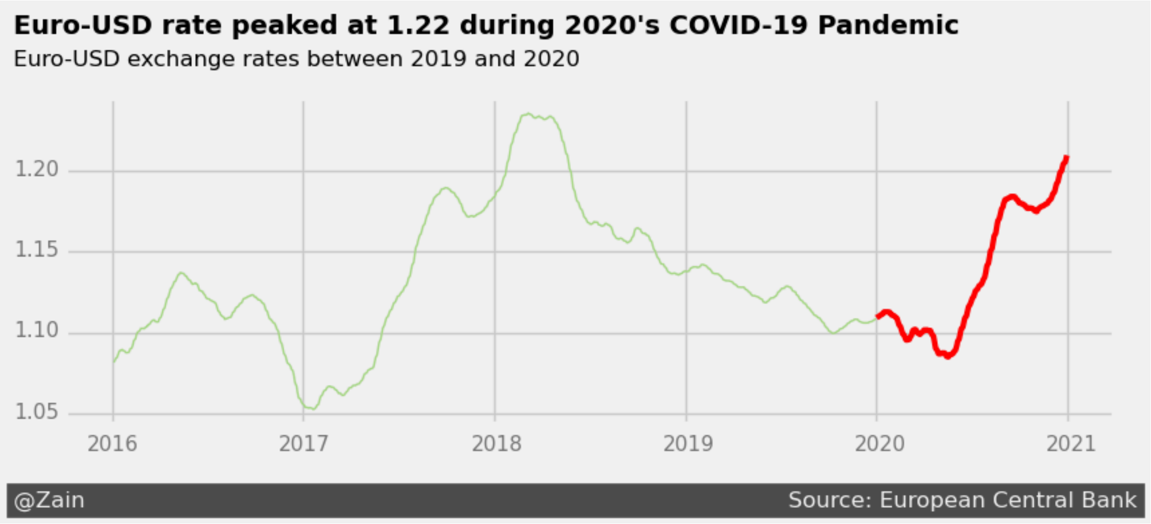
Euro-USD rate peaked at 1.59 during 2007-2008's financial crisis

Euro-USD exchange rates between 2006 and 2010

Covid-19

In [17]:
```
corona_crisis_20 = euro_to_dollar.loc[(euro_to_dollar["Time"]>='2020-01-1')&
corona_crisis = euro_to_dollar.loc[(euro_to_dollar["Time"]>='2016-01-1')&(eu
```

In [18]:
```
import matplotlib.style as style
style.use("fivethirtyeight")
# Adding the plot
fig,ax = plt.subplots(figsize=(9,3))
ax.plot(corona_crisis["Time"],corona_crisis["rolling_mean"],linewidth=1,colo
# Highlighting 2007-2008 period
ax.plot(corona_crisis_20["Time"],
       corona_crisis_20["rolling_mean"],
       linewidth = 3, color = "red")
# Labels
ax.set_xticklabels([])
x = 0.02
for year in ['2016','2017','2018','2019','2020','2021']:
    ax.text(x,-0.08,year, alpha=0.5,fontsize=11,transform=plt.gca().transAxe
    x+=0.183
ax.set_yticklabels([])
y = 0.02
for rate in ['1.05','1.10','1.15','1.20']:
    ax.text(-0.05,y,rate,alpha=0.5,fontsize=11,transform=plt.gca().transAxes
    y+=0.248
# Adding title and subtitle
ax.text(-0.05,1.2,"Euro-USD rate peaked at 1.22 during 2020's COVID-19 Pande
       weight='bold',transform=plt.gca().transAxes)
ax.text(-.05,1.1,"Euro-USD exchange rates between 2019 and 2020",size=12,tra
#Adding a signature
ax.text(-0.05,-0.25,'@Zain' + ' '*100 + 'Source: European Central Bank',
       color = '#f0f0f0', backgroundcolor="#4d4d4d",size=12,transform=plt.gc
plt.show()
```



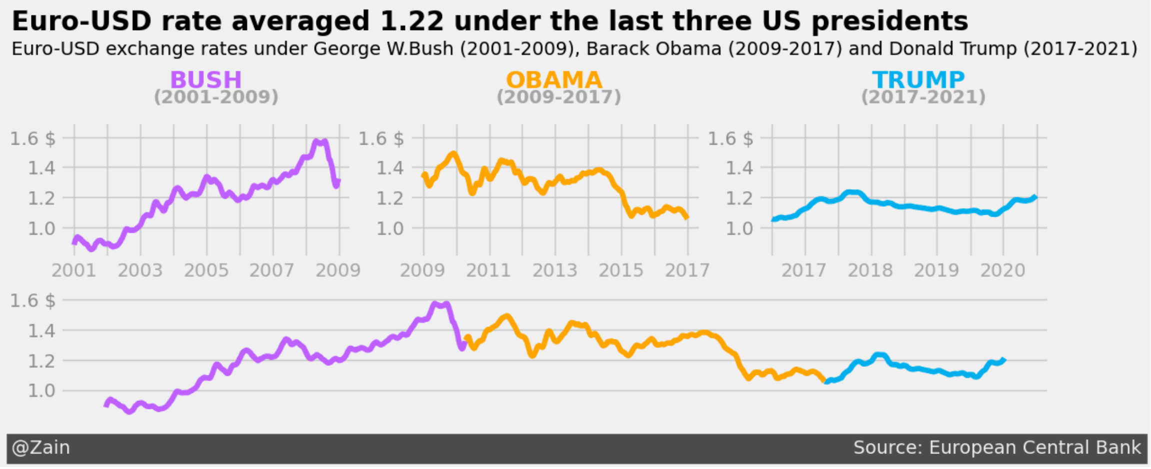
U.S Presidencies Comparision

In [19]:

```
bush_obama_trump = euro_to_dollar.copy(
                    )[(euro_to_dollar["Time"].dt.year >= 2001)&(euro_to_doll
bush = bush_obama_trump.copy(
        )[bush_obama_trump["Time"].dt.year <2009]
obama = bush_obama_trump.copy(
        )[(bush_obama_trump["Time"].dt.year >= 2009)&(bush_obama_trump["Time
trump = bush_obama_trump.copy(
        )[(bush_obama_trump["Time"].dt.year >= 2017)&(bush_obama_trump["Time
```

In [20]:

```
import matplotlib.style as style
style.use("fivethirtyeight")
#Adding the subplots
plt.figure(figsize=(12,6))
#pattern 1
ax1 = plt.subplot(3,3,1)
ax2 = plt.subplot(3,3,2)
ax3 = plt.subplot(3,3,3)
#pattern 2
ax4 = plt.subplot(3,1,2)
#Changes to all subplots
axes = [ax1,ax2,ax3,ax4]
for ax in axes:
    ax.set_ylim(0.8,1.7)
    ax.set_yticks([1.0,1.2,1.4,1.6])
    ax.set_yticklabels(['1.0','1.2','1.4','1.6 $'],alpha=0.4)
# Ax1: Bush
ax1.plot(bush["Time"],bush["rolling_mean"],color="#BF5FFF")
ax1.set_xticklabels(['','2001','','2003','','2005','','2007','','2009'],alph
ax1.text(0.11,2.45,'BUSH',fontsize=18,weight='bold',color='#BF5FFF',transfor
ax1.text(0.093,2.34,'(2001-2009)',weight='bold',alpha=0.3,transform=plt.gca(
# Ax2: Obama
ax2.plot(obama["Time"],obama["rolling_mean"],color="#ffa500")
ax2.set_xticklabels(['','2009','','2011','','2013','','2015','','2017'],alph
ax2.text(0.45,2.45,'OBAMA',fontsize=18,weight='bold',color='#ffa500',transfo
ax2.text(0.44,2.34,'(2009-2017)',weight='bold',alpha=0.3,transform=plt.gca()
# Ax3: Trump
ax3.plot(trump["Time"],trump["rolling_mean"],color = "#00B2EE")
ax3.set_xticklabels(['','2017','','2018','','2019','','2020','','2021'],alph
ax3.text(0.82,2.45,'TRUMP',fontsize=18,weight='bold',color='#00B2EE',transfo
ax3.text(0.808,2.34,'(2017-2021)',weight='bold',alpha=0.3,transform=plt.gca(
#Ax4: Bush-Obama-Trump
ax4.plot(bush["Time"],bush["rolling_mean"],color="#BF5FFF")
ax4.plot(obama["Time"],obama["rolling_mean"],color="#ffa500")
ax4.plot(trump["Time"],trump["rolling_mean"],color = "#00B2EE")
ax4.set_xticks([])
#Adding A title and subtitle
ax1.text(-0.05,2.88,"Euro-USD rate averaged 1.22 under the last three US pre
       weight='bold',transform=plt.gca().transAxes)
ax1.text(-.05,2.7,"Euro-USD exchange rates under George W.Bush (2001-2009),
         fontsize=14,transform=plt.gca().transAxes)
#Adding signature
ax.text(-0.05,-0.25,'@Zain' + ' '*135 + 'Source: European Central Bank',
       color = '#f0f0f0', backgroundcolor="#4d4d4d",size=14,transform=plt.gc
plt.savefig("Euro-USD exchange rate(2001-2021)")
plt.show()
```



Conclusion

Based on the analysis of the dataset from the European Central Bank, it's evident that the value of the US dollar relative to the euro exhibited notable fluctuations during different presidential administrations.

During the leadership of George Bush, the graph illustrates a significant depreciation of the dollar against the euro. This depreciation could be attributed to various factors, including economic policies, geopolitical events, and market sentiment during that period. For instance, the aftermath of the 2008 financial crisis, coupled with increased government spending and military interventions, might have contributed to a weakened dollar.

Under the leadership of Barack Obama, the graph indicates a more controlled trajectory, suggesting a stabilization of the dollar's value relative to the euro. This stability could be a result of economic stimulus measures, regulatory reforms, and diplomatic efforts aimed at restoring confidence in the US economy and financial markets post-crisis.

During the Trump administration, the graph shows relative stability in the dollar-euro exchange rate. This stability might be attributed to a combination of factors, including fiscal policies, trade negotiations, and market expectations. Despite the volatility in global markets and geopolitical tensions during this period, the administration's focus on economic growth and deregulation may have contributed to maintaining a stable exchange rate.

In conclusion, the fluctuations in the dollar-euro exchange rate observed across different presidential administrations reflect the interplay of various economic, political, and global factors. While each administration's policies and external events influence currency values differently, the analysis underscores the complex dynamics that shape exchange rate movements in the international financial landscape.

In [ ]: